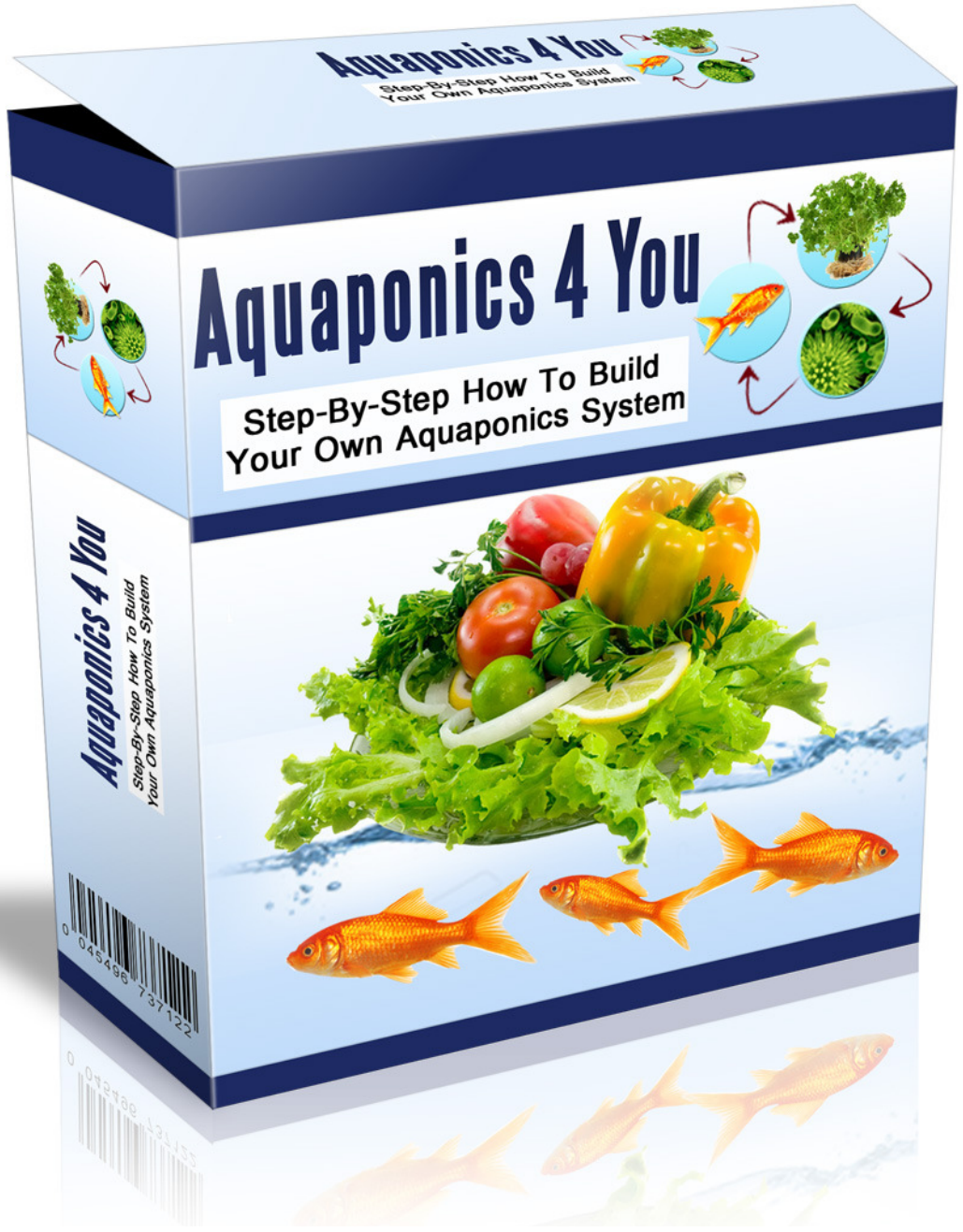
Aquaponics 4 You
Step-By-Step How To Build
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Introduction

Kick back, smile and enjoy the fact that you just made one of the smartest and most important purchases you could have made. Especially with the state of the economy today, it is good to know that with your Aquaponics system you are now in the food business – for yourself.

Imagine all the fresh organic greens and great tasting fresh fish you love to eat and now have plenty of; plenty to share with family, friends and neighbors.

Everything seems connected to oil just now, and oil is out of control – at least out of my control – don't know about you. Food prices as well, and with it, my peace of mind and sense of self-empowerment.

Aquaponics may be the tool to help us get back on track, since gardening is not everyone's thing. Bending over, dirty hands, weeding, pest control, soil repair and regeneration, etc. For some this is fun, and for others a serious disincentive.

With your Aquaponics Home System you are:

- ❖ Smart and highly sustainable
    - You will get plentiful, all-organic yields. And fast!

- Have low set-up and operating expenses.
- Grow most food groups.
- Have the choice of simply going off-grid – you could even run it manually.
- Indoors (e.g. in your garage or by the atrium window, or living room window) and just about anywhere outdoors.

❖ At ease even if you are a beginner

- Assembly is easy and straight-forward from simple materials – the majority of which you can buy off the shelf.
- Operation is simple (feed the fish, propagate the seeds and harvest the plants).

❖ At a financial advantage

- Off the shelf products.
- Easy assembly that doesn't require specialized labor.
- Plenty of options to use recycled materials.
- Save money by growing your own organic produce – the system will pay for itself in under a year.

The Aquaponics 4 You System is scalable. If you too love this and it works well for you, you may choose to upgrade to a three bed system, a full family system or even a commercial one.

Aquaculture meets Hydroponic Farming

And what a great match they are!

You produce both fish and organic fruits and vegetables in symbiosis with one another, because the fish provide an exceptional amount of bio-available nutrients and the vegetables clean up the water for the fish!

Don’t even think about using pesticides on your veggies – not that you’ll need to, since you are off the ground without weeds, soil pests or pathogens – but if you do, say goodbye to your fish, who act as the proverbial canary in the coal mine for the organic quality of your system.

Your produce tastes so much better than those grown hydroponically, and your fish will thrive better and easier than in any stand-alone aquaculture system.

Additionally, you save yourself 98% of the water it would take to grow the same amount of veggies in the ground, and your greens will thrive in half the time or less, much more densely planted. When you add this up you will find that you produce eight to ten times the amount of organic goodness that the same area of ground would have produced in the same amount of time. Wow!

No more bending over, either – the plants are grown at waist-level and can be harvested effortlessly.

And if you want to relocate your system, it's very easy – just drain and disassemble the system and move it. It's farming on-the-go.

You will use only a small amount of energy, which you may choose to harvest off-grid with a clever solar, wind or hydroelectric set-up. Or if you take it from your mains supply, you will only use ~$20 per month at peak US rates.

Growing your own food does not require a green thumb and a bad back – your Aquaponics 4 You System is easy to set-up and run.

Points to Consider

We recommend starting with the minimal set-up of the Aquaponics 4 You System as described herein so as to get thoroughly familiar with the aquaponics protocol before scaling up. The system that we are introducing herein is as simple as one can get. The entire aquaponics protocol has many different variables to consider:

Location, location, location

Where in the world do you live? How cold does it get in winter? Which plants/greens love your climate? What are your local fish options?

Where on your property will you locate your new aquaponics system? Sun, no sun, wind, rain, cold, views – you can make the system look sexy right in the center of your entertainment space or place it in the garage.

You will need sun or an alternate heat and light source to keep the water at optimal temperature for the fish. Consider placing your system in your garage or a small greenhouse for warmth if you live in cold climates. The Aquaponics 4 You System is small enough and compact enough that it requires as little as 20 sq ft.

The Aquaponics 4 You System raises your plants above the ground, so even poisoned, polluted and barren soil will work fine. If you raise it high enough you

could also plant your control group in the ground below it if that's what you need to fully appreciate the miracle of your new aquaponics system!

(Raising your veggie beds will make harvesting even easier – a literal walk in the park…)

Yummy Food

What greens and/or vegetables do you like? Think types of lettuces, dark leafy greens, tomatoes, cucumbers, culinary herbs, cabbages, oriental stir fry varieties, silver beets, kohlrabi, green onions, chives, leeks, etc…

With a green- or screen- house or in your garage with good full spectrum lighting, fruiting plants such as melons, cucumbers, squashes, tomatoes, strawberries, peppers, okra, and legumes such as peas, sugar snap peas, purple beans, green beans and others will do very well.

Check out sites such as http://www.seedsofchange.com or http://www.horizonherbs.com for organic seed options.

By the way, using the water from the system to irrigate ground-based plants is extremely beneficial to those plants as well. Sweet potatoes, carrots, onions, asparagus, bush crops, and so on, all love the nutrient-rich aquaponics water.

And of course the fish!

Contact your local University or Ag extension office to find out which fish are legal and/or available to be grown in your state or country.

Some common species used in aquaponics systems are: Tilapia, Chinese Catfish, Koi, Bluegill, Crappie, Largemouth and Smallmouth Bass to name a few.

Key Concepts Simplified

Here is how it works:

Keep a number of the appropriate fish in a simple container filled with their favorite stuff: water.

Care for the fish: Aerate the water for optimal dissolved oxygen levels (DO) and provide yummy fish food twice a day, which can be automated, and make sure they don't get too cold. On a weekly basis, check the water pH level to make sure that it remains at optimal levels.

Through a two-step process, nitrifying bacteria will turn the fish excrement from toxic ammonia into valuable nitrates, providing the fundamental growing nutrients for your favorite plants.

Propagate seeds in netted pots. The roots will reach into the water, extracting the nutrients and effectively cleaning the water for the fish.

Pump the water flow from the fish pond on the ground up to table level height where the veggie container(s) are and gravity will deliver the filtered water back to your fish nice and clean.

Chemistry/ Physics

There are really only 3 chemistry/ physics concepts to understand. Get yourself a test kit to play with, which is the easiest way to learn about what's happening in the tanks at all times. In the beginning, as you are optimizing your system, you will need to test more frequently, but within a few weeks you will end up testing less and less as you fully understand the relevant concepts.

Do test! Find a way to look at testing the physical parameters as play, exploration, life and death – whatever keeps you at it until it clicks!

Happy fish = high plant yield

Dead fish = no plant yield

- Dissolved oxygen (DO)

  The fish need this to breathe and you either provide it with a small air pump connected to multiple 'airstones' deep in the fish pond alone, or you supplement a smaller pump with our special energy-saving solution as detailed in the construction portion of this manual. Aeration is critical to the survival of the fish, so you may want to consider back-up scenarios during potential power outages!

- Ammonia/ Nitrites/ Nitrates

Fish excrement and urine contain ammonia, which is toxic to the fish and vegetables.

The answer to this otherwise deadly problem is provided by nature itself: nitrifying bacteria that turn ammonium first into nitrites and then into nitrates. So before you can grow vegetables with the water from the fish tank you need to have nitrates.

It may take as long as 3 months for the nitrates to show up on their own naturally, so if you are in a hurry you may choose to inoculate your system and get the process going as early as one week. Solutions for quick inoculation are provided in the Materials List at the end of this manual.

- Additives: Calcium carbonate/ potassium carbonate/ iron chelate

When needed, the carbonates provide extra potassium and calcium to the plants and raise the pH as well.

If your plants seem a little yellow, they are probably iron deficient; add iron chelate directly into the grow bed and this will take care of the problem.

Targets

As you begin testing the water on a regular basis – more so during the startup phase – there are certain targets for each of the particular parameters.

- Dissolved Oxygen, DO – 80% saturation is the goal, as this allows for maximum nitrification rates. Empirically, this translates to not less than 4ppm.

- Temperature – The temperature for optimum growth of nitrifying bacteria is between 77-86° F (25-30° C). Anything in this range is ideal. Most of the fish you will select can comfortably tolerate cooler waters, and the plants themselves would prefer the lower end of this target.

- pH – This is an interesting target to work out, as there are at least three different variables at play here: fish, plants, and nitrifying bacteria. All things being considered, you want to be slightly basic with your water solution. A general high and low range, which should not be exceeded, is between 6.0 and 8.0. Plants prefer lower pH, and the fish prefer a higher pH, so it's best to try to aim for happy medium of 7.0

If the pH gets too low, you can always add Calcium Carbonate (crushed coral) or either Phosphoric Acid, di-sodium phosphate, or mono-sodium phosphate.

- Ammonia – Ammonia levels should not be allowed to exceed 6 ppm, which is already considered toxic. The goal is zero detectable ammonia or ammonium (the ionized version of ammonia). But of course therein lies the trick…zero detectable, but not zero, so in reality less than 1ppm is good. If there's no ammonia, there's no food for nitrosomonas, which means no food for nitrobacter, which means no food for the plants. Somehow, it all works out. QUICK TIP: Add the total fish population part by part to the goal of ~15 fish. In this way, the nitrifying bacteria will have a chance to "catch-up" to the increases in ammonia.

- Nitrates and Nitrites – As with Ammonia, nitrites are toxic to the fish in particular. Nitrates are necessary for plant growth.

  With nitrites, you do not want to exceed 6ppm, which again is already considered toxic. Keep nitrite levels at or below 1ppm. As for nitrates, which are more easily tolerated by the fish, normal acceptable operating range is between 10-20 ppm.

Getting Ready to Build the System: Sourcing the Components

So now that you understand the basics of Aquaponics, it's time to build the Aquaponics 4 You Home System. There are literally thousands of variations and modifications that one could make for an aquaponics system. The model herein proposed aims to produce a high-yield crop with minimal maintenance and care on a minimal amount of space, indoors or outdoors…

The first step after having reviewed this manual and watched the Aquaponics 4 You video is to source the parts.

There are three part components to the system: Fish, Plants, and Hardware.

Fish

A variety of freshwater fish can be used for aquaponics systems, the most popular of which are: Carp, Goldfish, Trout, Smallmouth Bass, Largemouth Bass, Catfish, Koi, Tilapia, Barramundi Jade Perch , Murray Cod, Silver Perch and Crayfish (Yes, Crayfish can be used as well).

Carp

Carp is the name for various species of oily freshwater fish, mostly native to Europe and Asia. Many species of carp have been domesticated and reared as food fish across Europe and Asia for thousands of years.

Goldfish

The goldfish is a freshwater fish which was one of the earliest fish to be domesticated, and is one of the most commonly kept aquarium fish.

Goldfish breeds vary greatly in size, body shape, fin configuration and coloration (various combinations of white, yellow, orange, red, brown, and black are known).

Trout

Trout , which belong to the same family as the salmon, live in different environments and can have dramatically different colorations and patterns. Mostly, these colors and patterns function as camouflage and will change as the fish moves to different habitats.

Smallmouth Bass

The smallmouth bass is generally brown (seldom yellow) with red eyes,and dark brown vertical bands, rather than a horizontal band along the side. There are 13–15 soft rays in the dorsal fin. The upper jaw of smallmouth bass extends to the middle of the eye.

Largemouth Bass

The largemouth is an olive green fish, marked by a series of dark, sometimes black, blotches forming a jagged horizontal stripe along each flank. In comparison to age, a female bass is larger than a male. The largemouth is the largest of the black basses, reaching a maximum recorded overall length of 29.5 in (75 cm)

Catfish

Catfishes are a diverse group of ray-finned fish. Named for their prominent barbels, which resemble a cat's whiskers, catfish range in size and behavior from the heaviest and longest. Catfish are of considerable commercial importance; many of the larger species are farmed or fished for food.

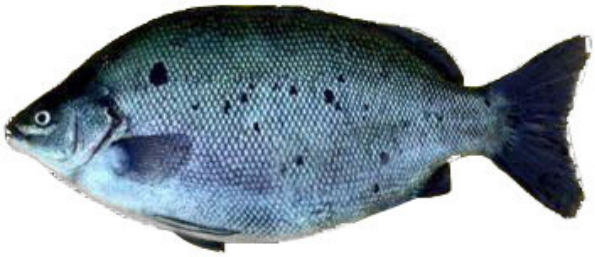
Tilapia

Tilapia is the fifth most important fish in fish farming, with production reaching 1,505,804 metric tons in 2000. Because of their large size, rapid growth, and palatability, tilapiine cichlids are the focus of major farming efforts. Like other large fish, they are a good source of protein and popular among artisanal and commercial fisheries.

Koi

Koi are ornamental varieties of domesticated common carp that are kept for decorative purposes in outdoor koi ponds or water gardens. Koi varieties are distinguished by coloration, patterning, and scalation. Some of the major colors are white, black, red, yellow, blue, and cream.

Jade Perch



Jade Perch is one of Australia's heavy built fish with a small head. It is generally bluish black in color and the fins are darker than the body. It can be can be distinguished by their anal fin which has eight rays and can grow up to 35cm.

Barramundi

The Barramundi in the U.S. is farmed in an environmentally sound way, making it a "Best Choice." There are concerns about how barramundi from Australia is produced, but it is still a "Good Alternative" to barramundi from other areas of the Indo-Pacific.

Murray Cod

The Murray cod is a large Australian predatory freshwater fish. Although the species is called cod, it is not related to the northern hemisphere marine cod species. Other common names for Murray cod include cod, greenfish and goodoo.

Silver Perch

Silver perch is a medium sized freshwater fish endemic to the Murray-Darling river system in south-eastern Australia.

They can commonly grow to 1–2 kg in size, but have been recorded to as much as 8 kg in the past.

Crayfish

Crayfish, crawfish, or crawdads are freshwater crustaceans resembling small lobsters, to which they are related. Most crayfish cannot tolerate polluted water. Crayfish feed on living and dead animals and plants.

In the United States and Canada, local regulations allow for the growing of certain of these freshwater fish, so you will need to check with your local University, Agricultural Extension office, or even pet store to determine what you can use in your specific geographical area.

The decision now is whether to buy Fry or Fingerlings. The fish fry will cost you less, but they will take longer to mature, which equates to a longer time to reach

adequate nitrate levels and system optimization. Conversely, although the fingerlings will be more expensive relative to the fry, they will be churning out more excrement early on during the system optimization process, which in turn equates to an earlier start on growing vegetables. You decide. You can even locate a local aquaculturist and buy mature fish directly.

Beware of adding Fry to adult fish; they may be eaten. So, in case you are contemplating to raise your own fish, use a separate hatchery tub.

Plants

Based upon your decision surrounding your choice of fish, and the stage of their maturity, you will now need to think about your plants.

The Aquaponics 4 You System is a float based system, and you can either start your seedlings already in the floats or you can transfer the shoots from a seedling bed attached to the system (an option for which your plans here allow) or from a conventional seedling tray.

At this point, a quick discussion of float systems (also known as “raft” systems) is apt. In a raft system the plants are grown on Styrofoam boards or similar material that floats on top of the water. In most cases, this tank (the grow bed) is separate from the fish tank. Water flows continuously between the two tanks. The beneficial Nitrosomanas and Nitrobacter bacteria live throughout the system. Their biology is such that they need a substrate – or surface – on which to attach for their life cycle. This ends up being the walls of the tank, the pipes, the underside of the floats, and, interestingly enough, the very roots of the plants themselves. Having a separated raft tank provides extra benefit in that the raft tank provides an added buffer for the fish (in terms of water quality and quantity), reducing stress and potential water quality problems. This is one of the greatest

benefits of the raft system. Raft / float systems optimize floor space and maximize growing space, which in the case of our Aquaponics 4 You Home System, makes it ideal for beginners who have limited space.

To maximize the system, you want to opt to sprout your plants in a separate grow bed and only transfer them once the roots are long enough to become part of the show – i.e. filter the water for nutrients while cleaning it for the fish.

As for the starter medium for the seedling pots, we recommend coconut fiber. It holds both water and air very well and is a great natural organic choice. Use net pots filled with coconut fiber and place the seeds inside. Then, water twice a day, ideally with the nutrient-rich Aquaponics water. Thin out the seedlings and delight in the young life!

Once the seedlings have reached maturity – generally 2-3 weeks for leafy greens – you will need to transfer them to the grow beds. You will quickly learn the grow times and maturation times of the various plants that you select to grow. Have fun, experiment with different varieties and combinations. The goal is to have a continually rotating crop base that is constantly yielding while seedlings are growing.

Hardware

The complete list of necessary hardware components for the Aquaponics 4 You System which we will be referencing throughout the Step-By-Step process can be found in the How-To section of this manual.

Most of the hardware can be found at a local hardware store: Eagle's, Lowe's, Home Depot, Ace Hardware, True Value, Do It Best, etc.

In addition to the plants and fish mentioned above, you will need piping, valves, water pump, aerator and tanks. The tanks can be purchased online (sites provided), modified from available materials, or found at a local animal feed store (such as for sheep, cattle and other livestock). **We recommend sourcing the tanks locally, as they are the single most expensive component of the entire system.**

It's not much at all, and fits together quite neatly in an efficient and attractive package. You'll see!

Building the Aquaponics 4 You System

Ok, you've sourced the materials, now it's time to build the unit; your fish and plants will be needing a home!

Important Considerations and Key Topics

- Climate – This system assumes a geographical location that provides for optimal sunlight exposure and temperatures year-round. If your specific climate region varies greatly from season to season, a combination of water heaters, greenhouses, or indoor housing may be required to protect the fish and plants from temperature extremes, which are almost always negative temperature extremes (of course if you plan on setting up shop in the middle of the Sahara or Death Valley you'd have to account for upper temperature extremes too!). So let's say you live in an area that receives snow or extreme cold during the winter months. In this case you have several options. If your system needs to be outdoors, you can either place the system in a greenhouse whereby the ambient temperature can be more closely regulated for the plants' benefit, or you simply accept the fact that for 4-6 months of the year you won't have plant growth. There are many cold water species of fish that handle near-freezing water temperatures,

but in such cases your plants won't grow, and the fish themselves won't be that active in producing the otherwise necessary excrement. Also, if you opt for this route, you will need to attach some sort of mechanical bio-filter or replace a percentage of the fish tank water on a regular basis (without plant growth and bacteria growth – both of which are mitigated by temperature – ammonia levels will quickly creep up to toxic levels if no filtration / water cleansing solution is provided). So if you want year-round produce, erect a greenhouse OR, conversely, if you can locate the unit inside your house, then all you need is to be sure that the plants either get good sun exposure through windows or you can provide full spectrum lighting for the plants. Locating the system indoors is not complicated on account of the next two topics of discussion – size and scalability.

- Size – The system for which we provide step-by-step building instructions ideally requires ~30 sq ft of floor space for comfortable operation, but if you are comfortable with close quarters, 20 sq ft will suffice.

- Scalability – The Aquaponics 4 You System is fully scalable. If you find that the initial construction and operation set-up does not adequately meet your desired needs for vegetable crops, it is easy enough to upgrade and

expand the same basic model upwards. If you want to modify the system from the get-go, you could increase the size of the main fish tank to meet your needs. The chemistry and biology considerations are the same either way. The simple formula for initial experimentation should be an equal amount of grow bed space as fish tank space (in volume, and keeping in mind the fact that the fish will be in deeper water, and the plants in shallower water). Exact ratios are discussed later in this manual.

- Water level – Once the target water level is achieved (this is addressed in the "Adding Water, Fish and Plants" section) you will likely need to add water from time to time. Although evaporation is minimal due to the floats and recirculation, there will nonetheless be some evaporation over time, and the plants will be using up water for their own growth. For this system, you may find the need to add a few gallons every week to two weeks depending upon ambient humidity. Since you will have optimized your system, and in particular removed chlorine from the system, you don't just want to turn on the hose and "fill 'er up". Instead, keep a 5 gallon bucket handy. A few days before you anticipate needing to add water, simply fill up the bucket with water and wait two days while the chlorine naturally

"evaporates-off". This topic of water conditioning is further discussed in the "Adding Water, Fish and Plants" section.

- System types – As discussed earlier, there are essentially two types of aquaponics systems: those that use a grow bed medium like clay, gravel or sand for actually anchoring the plant roots in slow-moving and percolating water, or a float based system in which the plants are suspended on floats in more-rapidly (and constantly) circulating water. There are numerous considerations for either methodology, but the advantage of the float based system is that it is fully scalable, and nutrients tend to be more readily available to the plants as the water is in constant circulation. Also, no clay or growing media to clean on an annual / semi-annual basis. Huge commercial float operations can be built using the principles derived herein from our 200 gallon, two tank float system.

- Costs – The total cost for the system design that we have specified herein is approximately $400 for all new parts and equipment. The tanks are the one item that you can source more creatively, as there are many ways to hold fish and plants. We provide the easy solution, which is not always the

cheapest. Also, your final scalability/size determinants may increase or decrease this rough estimate considerably.

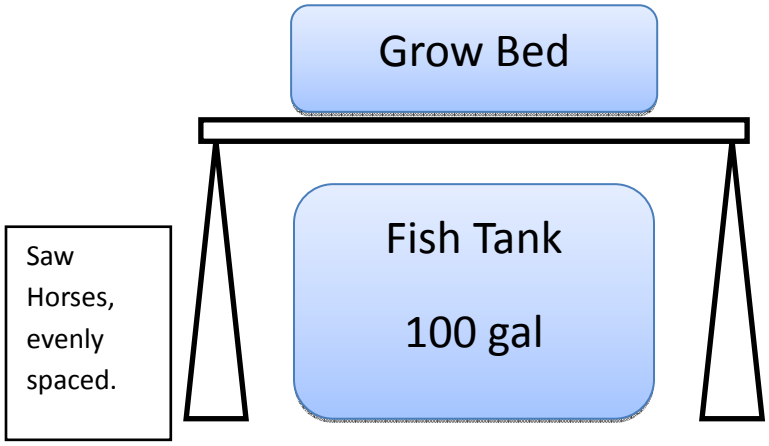
STEP ONE – Laying Out the Tanks

The first step is to place the two tanks. The fish tank feeds the grow bed, and the grow bed returns the filtered water back to the fish tank, so its location sets the stage for how everything else will be set up.

As you take a preliminary look at the diagram in the next page (Diagram 1), you will note that we have placed the 50 gallon grow bed on top of the 100 gallon fish tank. In this fashion, you maximize floor space and effectively occupy only ~20 sq ft.

The Aquaponics 4 You System incorporates a raised shelf for the grow beds, since it's far more convenient and comfortable to garden at waist level rather than bending over.

General Layout – Diagram 1



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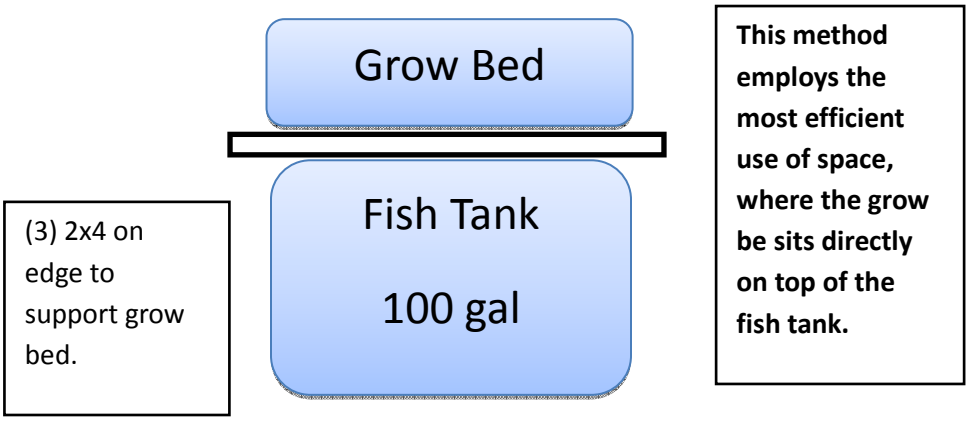


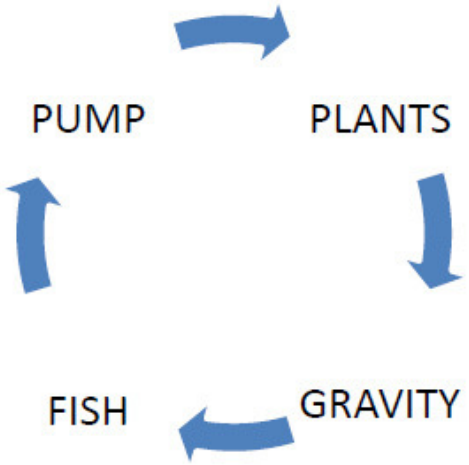
Also, with the fish tank directly below the grow bed, you save on piping material and on space. You will need to construct a rudimentary shelf upon which the grow bed will sit. A gap in the middle of the uprights is required for the placement of the 100 gallon fish tank.

For our purposes, we recommend purchasing two “Saw Horses” that are rated to hold at least 150 pounds each. Alternatively, any strong counter top or work chest top can serve as the level upon which the grow bed sits.

Essentially, you need a flat surface that can support the weight of the 50 gallon grow bed, which when filled to the desired height will weigh approximately 300 lbs when holding 8” of water. Depending upon the material that you choose for making your countertop surface for the grow bed, you may need to reinforce the middle span that sits over the main fish tank. A quick solution to this middle span is to purchase three 8’ 2x4 (at a cost of under $13), place them on edge, and there you have a joist system that is strong enough to hold the weight of the grow bed tank across the ~4-5 foot span.

STEP TWO – Connecting the PVC feeder pipe to the Grow Bed

Now that you've positioned the grow bed and the main fish tank, it's time to connect them together via schedule 40 PVC pipe. Due to the pump output characteristics, for the feeder supply side of the installation, we'll be using ½" PVC. The flow of water moves as follows:



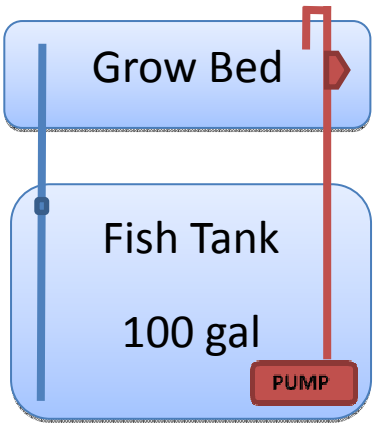
To cut the PVC, you can use a host of tools. The easiest is a PVC pipe cutter, approximately $10. But for such a small job, you can also use a hacksaw, circular saw (watch out for flying parts), or Sawzall.

Since the pipes will never be under great pressure, you can use medium grade clear PVC pipe cement for the joints and fittings. Exact lengths and measurements will vary from system to system depending on the final layout that you choose,

but it's safe to assume that you won't need more than 6' of ½" schedule 40 PVC, and 6' of 1" schedule 40 PVC

Looking at the below diagram, start by assembling the water pipe from the pump to the grow bed – the red line. Place the pump on the bottom of the fish tank and carefully screw on the ½" female threaded adapter/coupler onto the output of the pump (the hole pointing up).

The **BLUE** gravity return pipes sit in the back center of the Grow Bed, approximately 2" from the back wall. The back wall is defined as the wall that is most opposite from the incoming **RED** pumped water. The return pipe sits 8" up into the tank, thereby establishing the water tank depth at 8".



Install inline valve just prior to the entrance to the grow bed tank…allows for isolation of Grow Bed if desired.

Red = Pumped water from Fish Tank

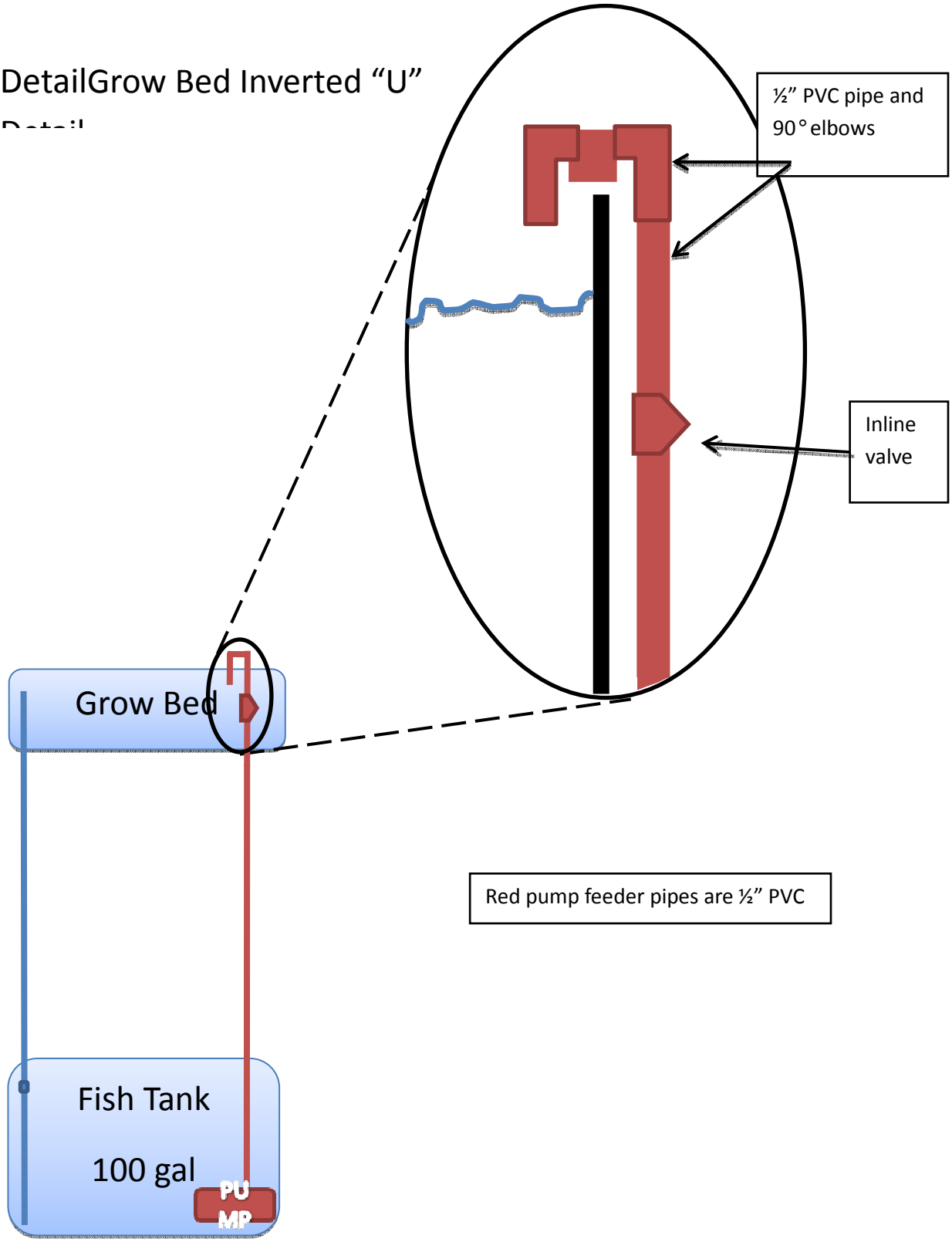
Blue = Return Gravity flow water from Grow Bed

Now, measure the distance from this newly-installed coupler to midway of the grow bed that sits above the fish tank. This distance should be in the range of 3-4 feet. Cut a length of ½"PVC tubing and glue it to the ½" pump coupling. Add the inline valve at this midway point up by the grow bed.

Now it's time to build the inverted "U". The diagram located in the next page displays a close-up of this inverted "U". Basically, the pumped water is coming from *underneath*, and therefore needs to be redirected back into the grow bed tank.

The pipe, therefore, will climb up along the outside wall of the grow bed, and when it reaches the top, you will add a 90 degree elbow, followed by a small 3-4 inch length of connector piece, followed by another 90 degree elbow that sends the water into the grow bed (dumping from high on the lip). Adding the valve on the vertical rise gives you the option of shutting off the water to the grow bed if desired (most likely if and when you need to service the pump).

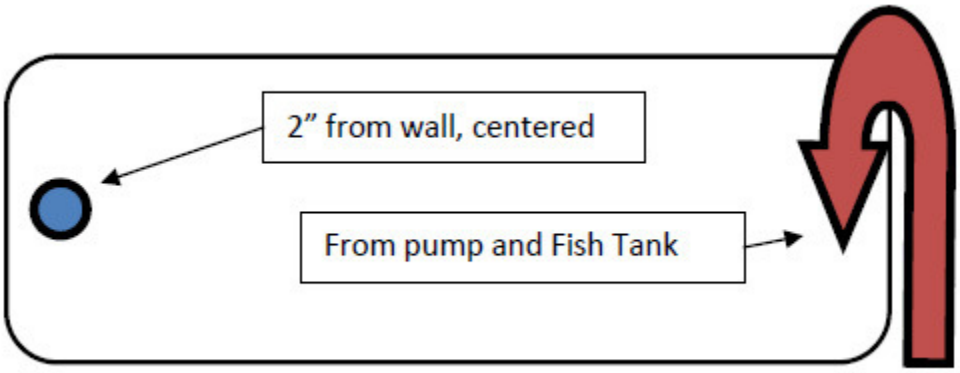
DetailGrow Bed Inverted “U”



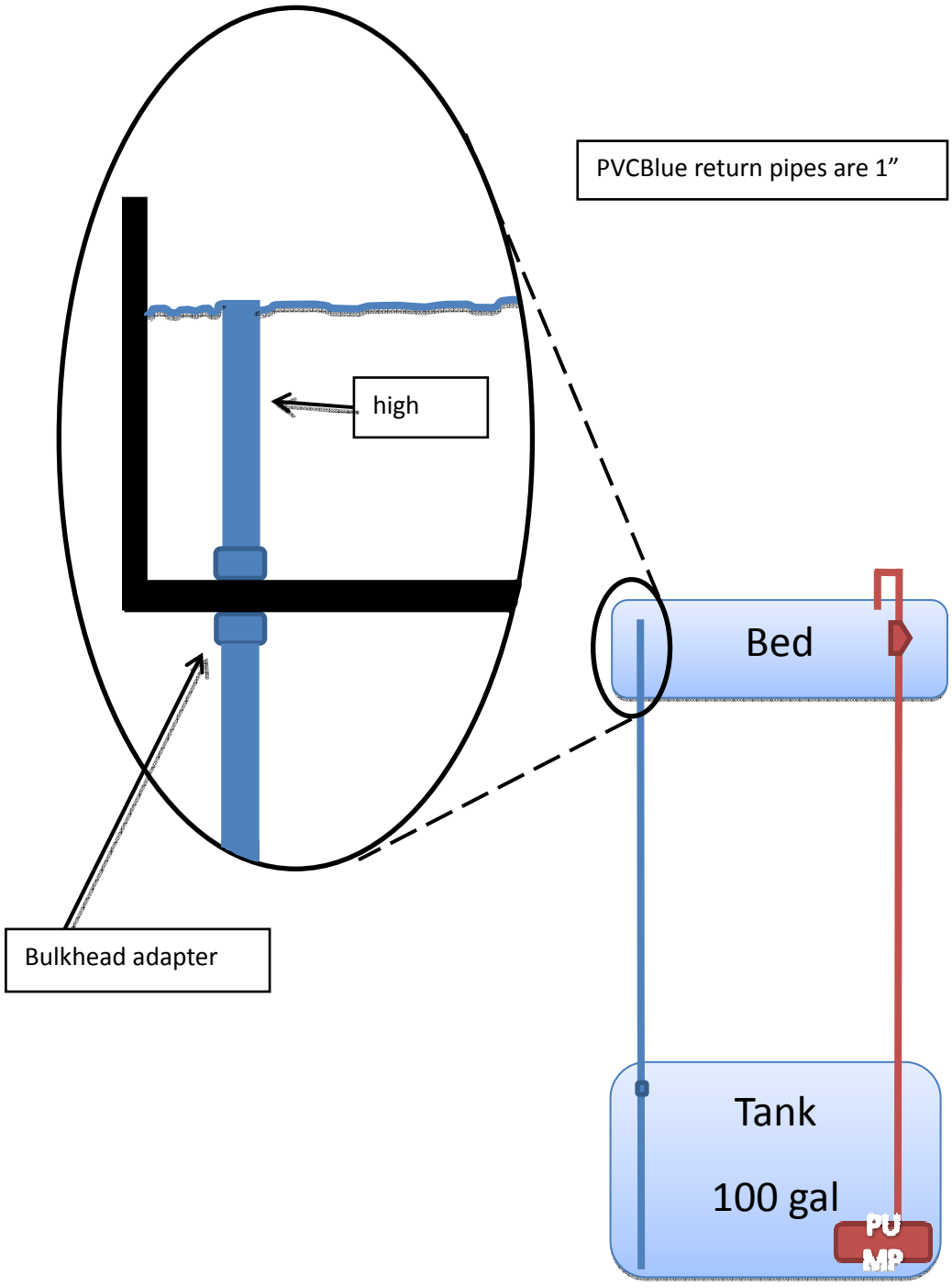
STEP THREE – Connecting the Return Pipes

Considering you've just completed the feed piping to the grow bed, assembling the return pipe will be a snap.

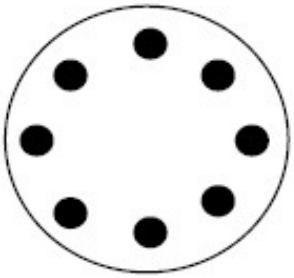
The next step is to drill one 1" hole in the far center bottom of each tank which will serve as the drain for each grow bed. You want to place the drain hole on the opposite side from where the water is entering the tank, approximately 2" from the wall, and centered. It should look roughly like this:



Referring to the below diagram:



Fit a bulkhead adapter to cover this hole. Cut an 9” piece of 1” PVC, and glue it into the female, inside-of-the-tank portion of the grow bed. On this standpipe, measure 1” down from the top, and drill eight (8) holes at around this circumference of this established height. Since you can punch holes through to the other side, you will really only be drilling four times. When viewed from above, it’s going to look like this:



In this fashion, you will have created an 8” standpipe that effectively sets the water depth of the grow bed at 8”. The extra 1” of pipe above the vertical ring of holes keeps the floats from blocking the return. This depth allows for good nutrient circulation and gives the roots ample room to grow down into the grow bed from their float homes.

On the underside of the grow bed, attach a 1” threaded female coupler to the threaded male end of the bulkhead. See **Figure 4** for a close-up of how this portion of the installation looks.

It's time to assemble the venturi aeration ports. Refer to **Figure 5** for the simple construction of these aeration ports. Approximately 5 inches above the desired water level in the tank – which is at least 18" – cut the PVC pipe coming from the grow bed at the appropriate length. Affix a 1" to ½" reducer, then add a 3" piece of ½"PVC, then add a secondary reducer to bring the size back up to 1" PVC. By constricting the water thusly, and with the single aeration hole that you will drill into this ½" PVC insert, you effectively create a small aeration suction port that will add air (Oxygen) to the water as it returns. Might as well capture some "free" aeration when we can!

Finally, cut the remaining piece of 1" PVC to take the return water to the bottom of the tank. Put a 90 degree elbow on the very bottom so that the water enters the fish tank parallel with the bottom. It is indeed possible NOT to have the return pipes enter the fish tank at the bottom, but rather splash in at the top; however, by sending the bubbly, venture-aerated water deeper, it will continue to aerate the water column as the bubbles rise. The goal with this system is to have highly aerated, and continuously moving water.

Congratulations, you have finished the construction portion of the Aquaponics System!

Figure 4 – Grow Bed Drain

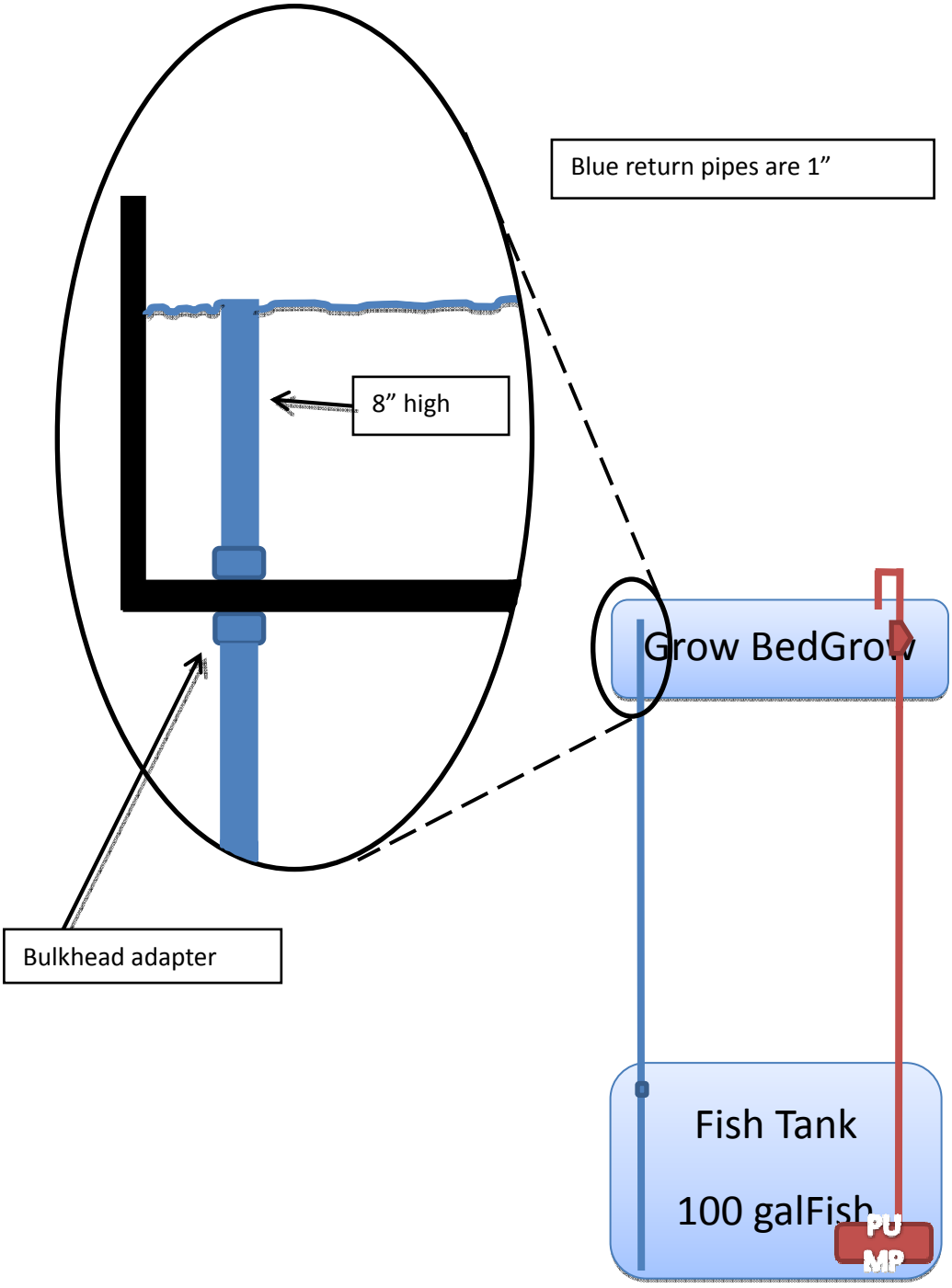
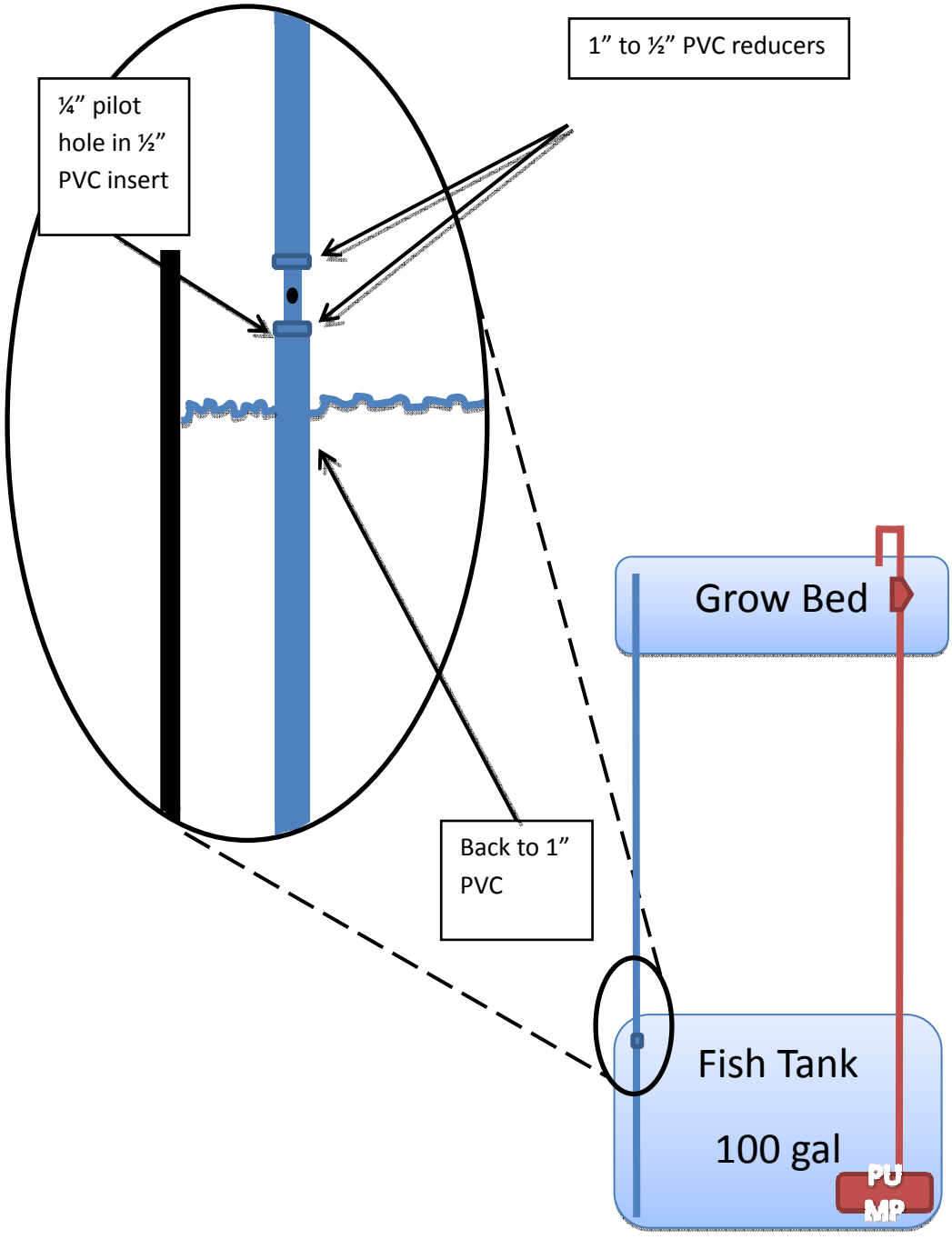


Figure 5 – Venturi aeration port



Adding Water, Fish and Plants

Water

Now that the system is built, it's time to add water.

Begin by filling up the grow bed until the max height of 8" is reached where you drilled the holes. Next, fill the fish tank up to 18".

Turn on the pump. Immediately the water level in the fish tank will fall, since all of the pipes will heretofore have been empty. Add more water to the fish tank as necessary to reach the desired 18".

This is a great time to check for any leaks in your system.

Assuming you have filled your tank with municipal water, which is more than likely treated with chlorine, you now either let the chlorine "evaporate-off" naturally through sun and atmospheric exposure (1-2 days), or you can dissolve it instantly with Sodium Thiosulfate. If you choose the evaporation method, let the system cycle through with the pump and aeration on for about two days.

Floats

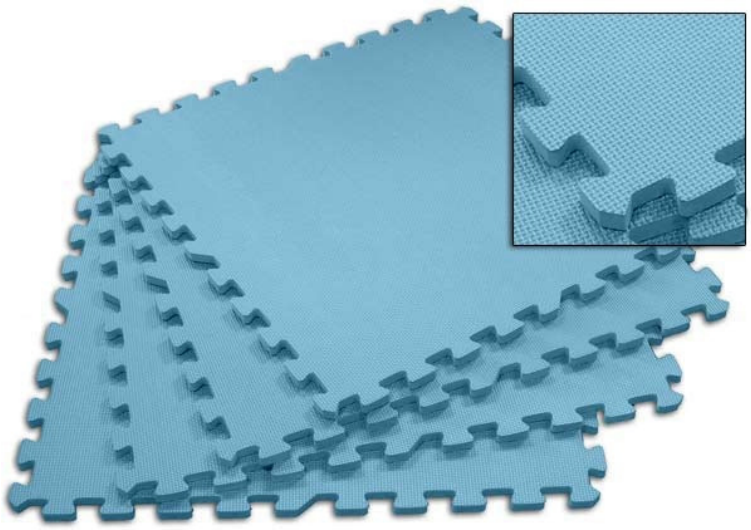
During the day or two that the water is outgasing its chlorine, you can quickly prepare the floats. The floats can be made of any floating media that can retain its integrity and positive buoyancy once several plant holes have been drilled.

One particularly common solution has been to use 4'x8' Dow Chemical, Closed Insulation Boards. They are approximately 1" thick, and hold their integrity well despite having numerous holes for the plants that they hold.

The one drawback that we have observed with these types of floats is that, while their integrity remains intact, they nonetheless shed small pieces of Styrofoam from the constant moving, placing of seedlings, and harvesting.

For this reason – and also for aesthetics – we recommend purchasing interlocking 12"x12" closed-cell mats, much like the kind that are used for children's play areas. The grow bed that we have selected is perfectly matched for these modified rafts.

The closed-cell foam does not shed when drilled or maneuvered, and because of their size, they are ideal for our small system. Furthermore, they can be sized to fit the grow beds almost precisely; even if you source your own grow beds.



Close Cell Foam Mats

Additionally, they allow for the greatest economy, as you can stack them in two layers if you are anticipating a heavy plant variety (think kale or broccoli), or leave them single layered for herbs, lettuces, and other low-weight varieties. Once you have the correct layout for the grow beds, you can zip tie the mats together or, if tight enough of a fit, they will stay together under pressure.

Drill between 4 evenly spaced 2” holes into the mats, depending upon what you anticipate growing. If you are growing larger seedlings, and will subsequently be having larger “net pots” – then size the holes appropriately.

Nitrifying Bacteria

With the chlorine now gone, it's time to add the ProLine Nitrifying Bacteria. In addition to the trace ammonia that is already present in the water from the de-chlorination process, the fish will be adding to this count on a daily basis as their excrement decomposes into ammonia and methane. In the very beginning, though, you will likely need to add a few tablets of ammonium chloride, the ammonia component of which is necessary food for the newly-added nitrifying bacteria.

This is where the nitrifying bacteria come in. Nitrosomonas bacteria converts ammonia into nitrites while removing CO2 for respiration, and Nitrobacter converts nitrites into nitrates.

The plants need nitrates, so keeping these two bacteria species happy is highly desirable. Keeping them happy is relatively easy. As they are photo sensitive, just keep floats on the grow bed to minimize sun exposure. Although the grow bed is essentially sitting on top of the fish tank, if outdoor, shade the fish tank from too much sun exposure. You might want to place a lid on the tank anyway, since some type of fish love 'exploring' at their peril…

In the beginning, beware of the nitrite spike. Remember, you want nitrates, yet Nitrobacter have a slower metabolism than Nitrosomonas, and after you add these nitrifying bacteria you will encounter a spike in nitrites at fist, which can be harmful to your fish as well. Your nitrates will show up eventually by day 4 or 5, but test to be sure.

Keep the pH level above 6.0 and below 8.0. Ideal range for all variables concerned is 7.0.

pH Level Testing

The pH level of water can be tested using either a standard pH test kit or using a digital pH Meter. These items can be easily bought online or from local aquarium stores.

Digital pH Tester

Standard ph Test Kit

Fish

OK, the bacteria have been added, so now add the fish. Actually, this step and the adding of bacteria step can be performed together or in close sequence. Assuming you have made your system to our specifications of water volume, where 18" of water in the 100 gallon tank is ~75 gallons, and 8" of water in the 50 gallon tank is ~37 gallons, then the ideal number of fish to begin with is ~15.

The optimal ratio for this system will eventually be ~10-15 pounds of fish for the total system, but assuming that you will be starting with younger fish, you will first begin with slightly larger numbers. Over time, you will need to harvest some of the fish to keep ideal ratios, which more-or-less equates to one pound of fish for every eight gallons of water. The acceptable ratio is actually double this number – or one pound of fish for every four gallons of water – but since the Aquaponics 4 You System is designed to be a space saver, which ultimately requires cutting down the grow bed space, we are decreasing our fish numbers to account for the decrease in plant growth surface area.

Be sure that the water is getting good aeration and degassing. Also, be sure that the float mats are inserted into the grow beds so as to minimize light exposure for the nitrifying bacteria.

Seedlings

If you have planned properly with your building schedule, by now your seedlings should be ready to add to the system. Carefully transfer the seedlings into the float mats.

Testing and Optimizing

With everything in place, the next two weeks will be important water chemistry monitoring weeks, as the system is adjusting and optimizing.

Remember the basics – good dissolved oxygen (aeration), low to not-detectable ammonia levels, target nitrate and nitrite levels, and well-fed fish. That's right….well-fed fish. But not overfed.

Learn what they like, feed them what they want (in quantity), but not more. A food source with a high protein value is ideal (30-40% protein) because this translates into faster growth and more excrement.

That's it! Get ready to eat some delicious vegetables in just a few weeks.

Congratulations!

Materials List

Tanks

(1) 100 gallon tank for fish, (1) 50 [53] gallon tank for plants. Can be found at www.usplastics.com , www.aquaticeco.com , www.plastic-mart.com , www.home-improvement-superstore.com or your local livestock feed store (commonly used as water troughs). The specific item numbers for the tanks that we recommend from www.plastic-mart.com are, 53 gallon rectangular tank, item #OTR482412, and from www.home-improvement-superstore.com the 100 gallon tank, item #776385. You can opt to purchase both the 50 gallon tank and 100 gallon tank from the same sources, but the reason we specifically recommend these two tanks are for their exact dimensions. The rectangular tank from plastic-mart, which we use for the rafts, has the perfect dimensions to accommodate the 12”x12” rafts. No cutting required. But cutting is not that complicated, so if it’s cheaper to buy the two tanks together, please do so. Should you want to buy both tanks from one supplier, home-improvement-superstore has the 50 gallon tank to go along with the 100 gallon tank, item #335015.

Admittedly, the problem with ordering online is that the shipping cost can be as much as the item cost, so it is almost always best to source these containers

locally – hence the feedstore/ livestock/ farm and garden supply store route. We have found 50 gallon tanks at Home Depot and Ace Hardware made by Rubbermaid. Remember, there are so many different creative solutions for the tanks, which are the single most costly item along with the pump. For example, an old bathtub would work great for holding the fish! Even a tall trash can!

Fish

Source locally from fish farms or pet stores. Craig's list is an excellent resource either to locate fish or to ask for fish, www.craigslist.org . You'd be surprised to discover run-of-the-mill characters who raise fish in their backyard for people just like you. Hey, you'll be one of them soon too!

Hardware

- Schedule 40 PVC, 1 inch
  - 6' pipe
  - (1) Bulkhead fitting*
  - (2) 1" to ½" PVC reducers (smooth on both ends)
  - (1) female threaded coupling (smooth on one end, threaded on other)

- Schedule 40 PVC, ½ inch
  - 6’ pipe
  - (1) inline valve
  - (1) female threaded coupling (smooth on one end, threaded on other)
  - (2) 90 degree elbows

- Pump – Danner Supreme Magnetic Drive Pump, MD5, available at www.aquaticeco.com. You can purchase your pump elsewhere, but in short you’re looking for ~6 gpm capacity across ~5-7 feet of head.

- Aerator / Air Pump – A simple air pump, such as the Silent Air X-5 Aquarium Air Pump found at www.aquariumguys.com is a good buy and has a five year warranty. Also, **you might want to consider a battery operated air pump as back-up in case of power outages**…they are cheap ($20), but can save you a world of grief should you ever lose power. Your local pet shop will likely have air pumps and supplies. You will also need to purchase airline tubing and two airstones (the pump has two outputs).

- Floats – www.ezgooddeals.com , standard ½" mats, 12"x12". One set.

- Miscellaneous
  - Medium strength clear PVC cement
  - (3) 8' 2x4 lumber to support the grow bed sitting on top of the fish tank.
  - Net Pots, 2" and 3" as desired, www.hydroponicgarden.net , or your local gardening supply store.
  - Coconut fiber, www.hydroponicgarden.net, or www.cleanairgardening.com , or your local gardening store.
  - Fish food.

- Water Chemistry
  - 1 gallon ProLine Nitrifying Bacteria, www.aquaticeco.com .
  - Chlorine neutralizer/remover… 4lb jar ProLine Dechlorinator, Sodium Thiosulfate, www.aquaticeco.com . This is if you don't want to wait for the chlorine to evaporate off naturally after a few days worth of circulating.

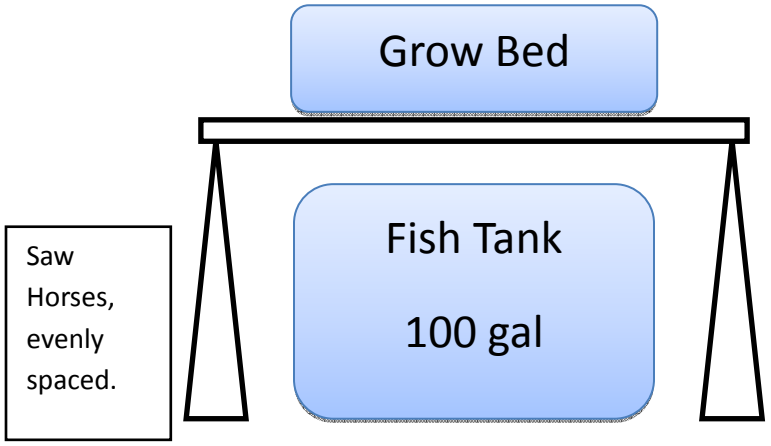
- Test strips for pH, ammonia, nitrites and nitrates, part number 214510, at www.aquariumguys.com.
- Calcium carbonate for raising pH as necessary, www.aquaticeco.com
- Ammonium chloride tablets to assist in the initial bacterial start-up process, www.aquariumguys.com .

❖ Tools

- PVC Pipe cutter tool (or hacksaw, sawzall, circular saw).
- Channel Lock pliers.
- Drill with 1" hole saw and ¼" drill bit.
- Optional hole saw sizes for floats.

Many of the hardware items listed above can be purchased locally, particularly all of the PVC fittings (*Bulkhead fitting excluded, which may need to be ordered).

Figure 1 – General Layout



OR

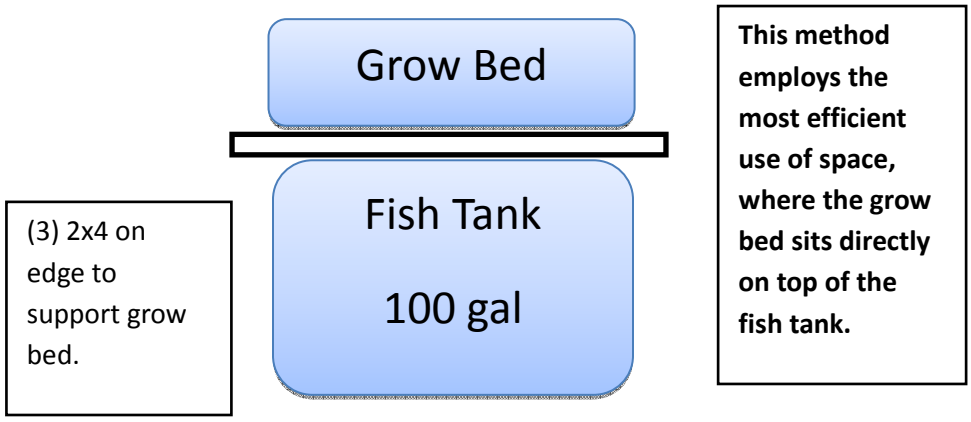
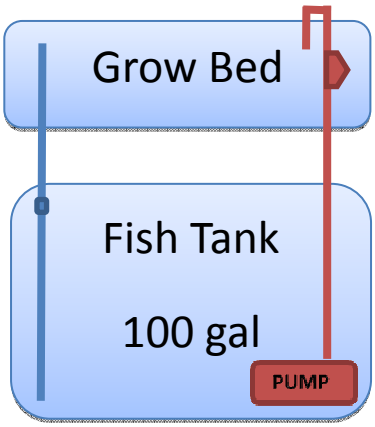


Figure 2 – PVC Pipe configuration

The **BLUE** gravity return pipes sit in the back center of the Grow Bed, approximately 2" from the back wall. The back wall is defined as the wall that is most opposite from the incoming **RED** pumped water. The return pipe sits 8" up into the tank, thereby establishing the water tank depth at 8".



Install inline valve just prior to the entrance into the grow bed tank…allows for isolation of Grow Bed if desired.

Red = Pumped water from Fish Tank

Blue = Return Gravity flow water from Grow Bed

Figure 3 - Grow Bed Inverted “U” Detail

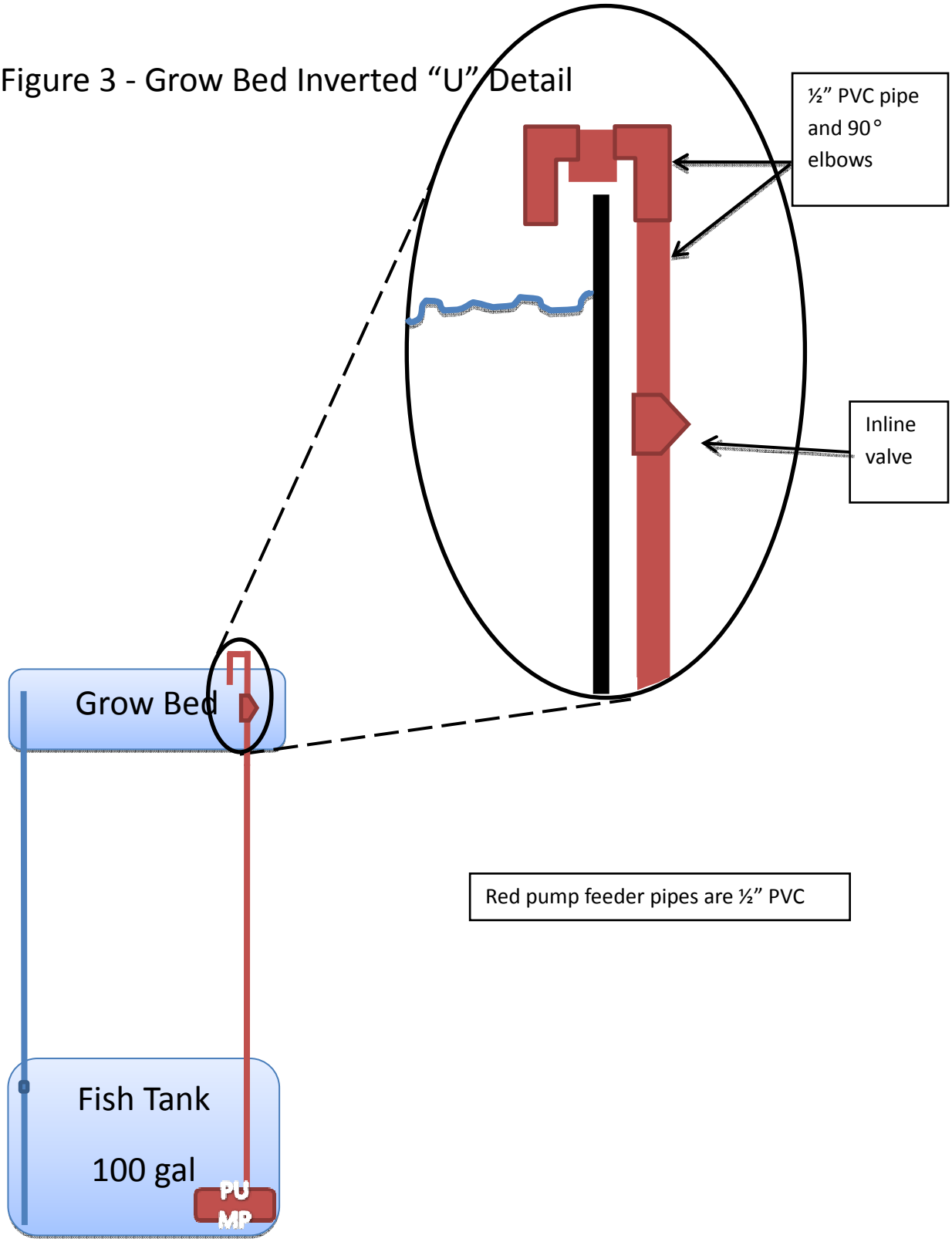


Figure 4 – Grow Bed Drain Detail

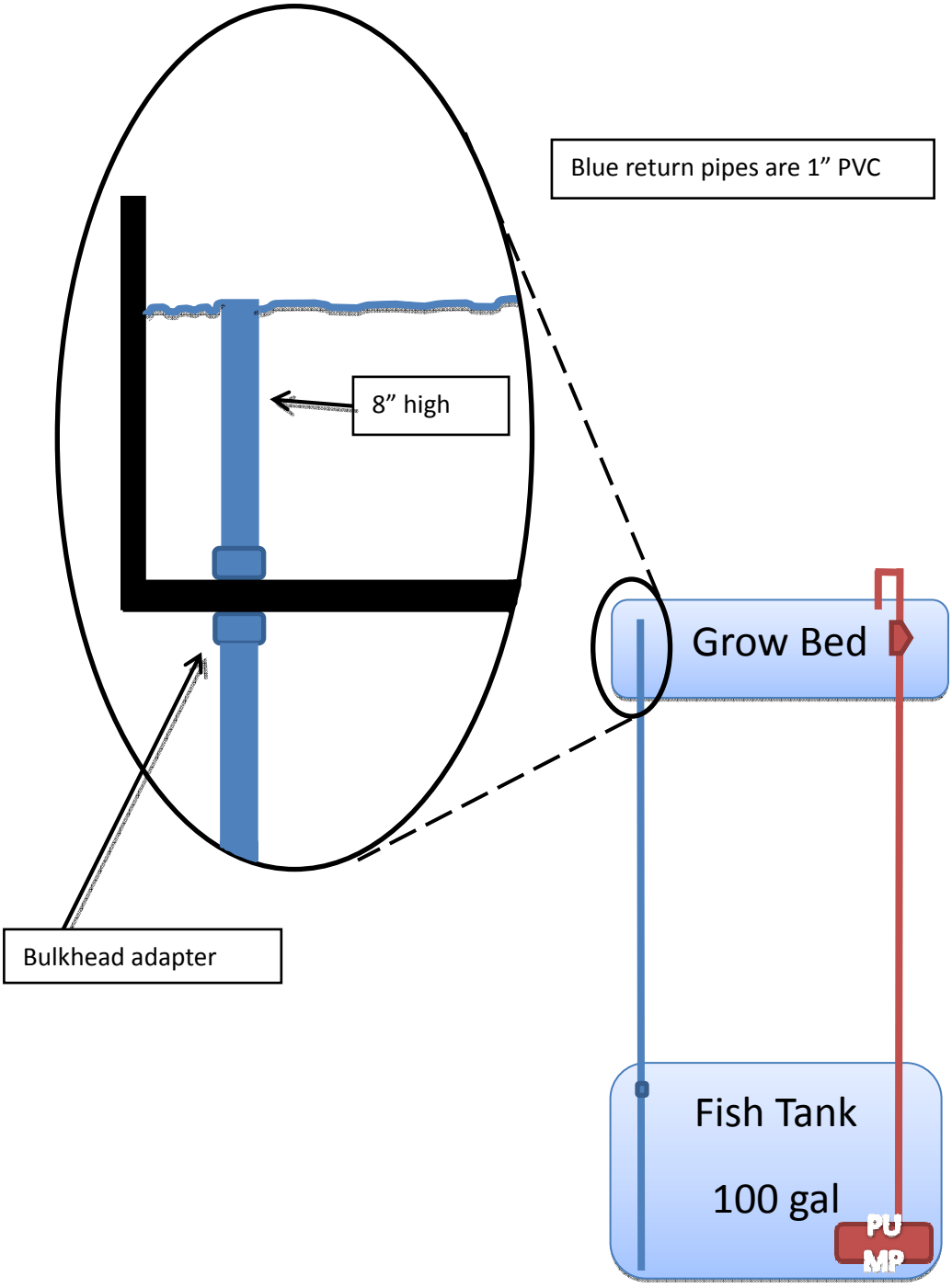


Figure 5 – Venturi aeration port